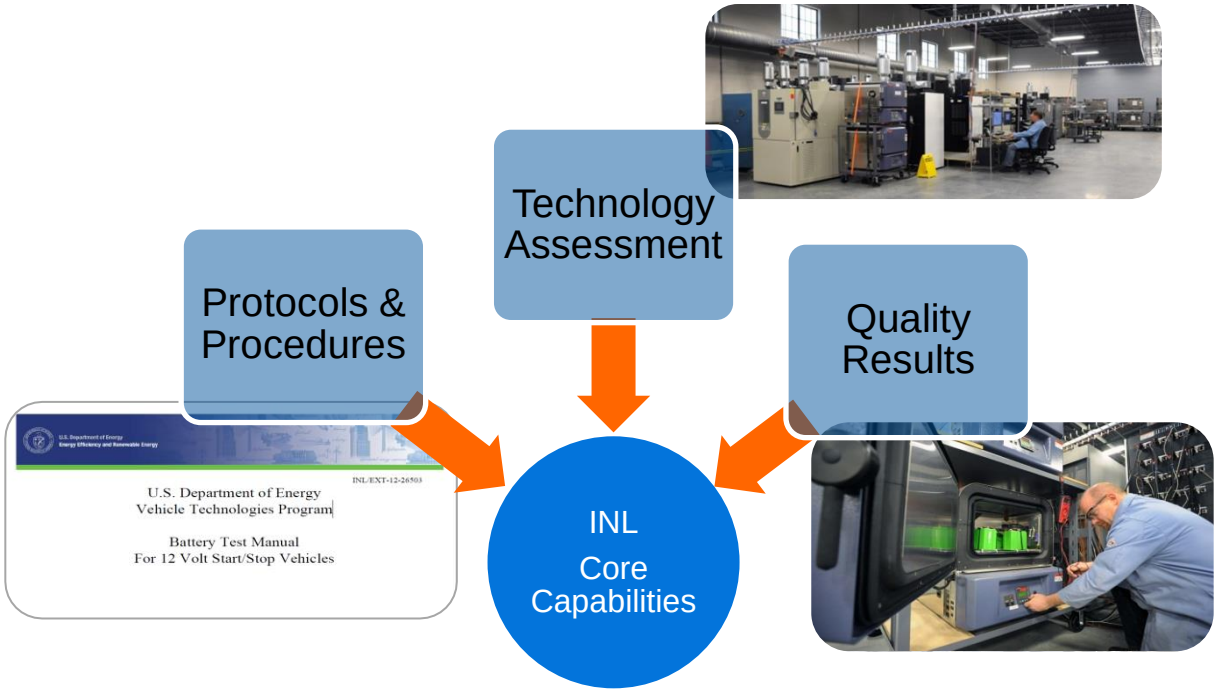
Testing Logistics (Setup to Teardown)



Mike Evans – Laboratory Lead Test Engineer

More exercise for some means the batteries are dead in the remote again.

Relevance

Independently evaluate batteries for the transportation sector.

- Performance assessment of energy storage devices against established targets
- Nationally recognized as high quality, high fidelity, and independent test center
- Assorted chemistries and formats
- Cycling, calendar life and cold crank with elevated temperatures
- Cells (5-12V) up to 250 amps, modules (40-60V) 275 amps, and packs (500-1000V) 500 amps

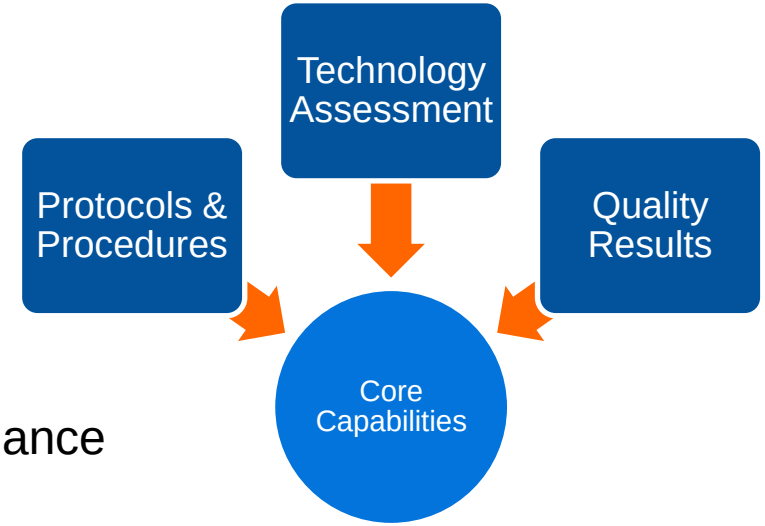
Battery Test Center named DOE Core Capability for Electrochemical Performance Testing

Relevance

Objective

***Independent**, science-based performance assessment of energy storage devices.*

- Environmental control
- Software analysis tools for data analysis and reporting.
- Standards developed for data acquisition, analysis, quality and management.



- **Protocols & Procedures**
  - Internationally accepted manuals for performance assessment of energy storage systems.
  - **Lead National Laboratory** for technical content and authorship with support from DOE and USABC.
- **Quality Results**
  - Flexible state-of-the-art energy storage test facility capable of supporting current and future development activities.
  - Rigorous NIST traceable calibration procedures for in depth uncertainty analysis.
  - Temperature controlled testing for reliable and repeatable results.

Equipment

- INL Battery Test Center
  - 20,000ft^2 lab space
  - 705 cell test channels
  - 27 module test channels
  - 7 pack test channels
  - >100 controllable thermal chambers
  - Vibration test system

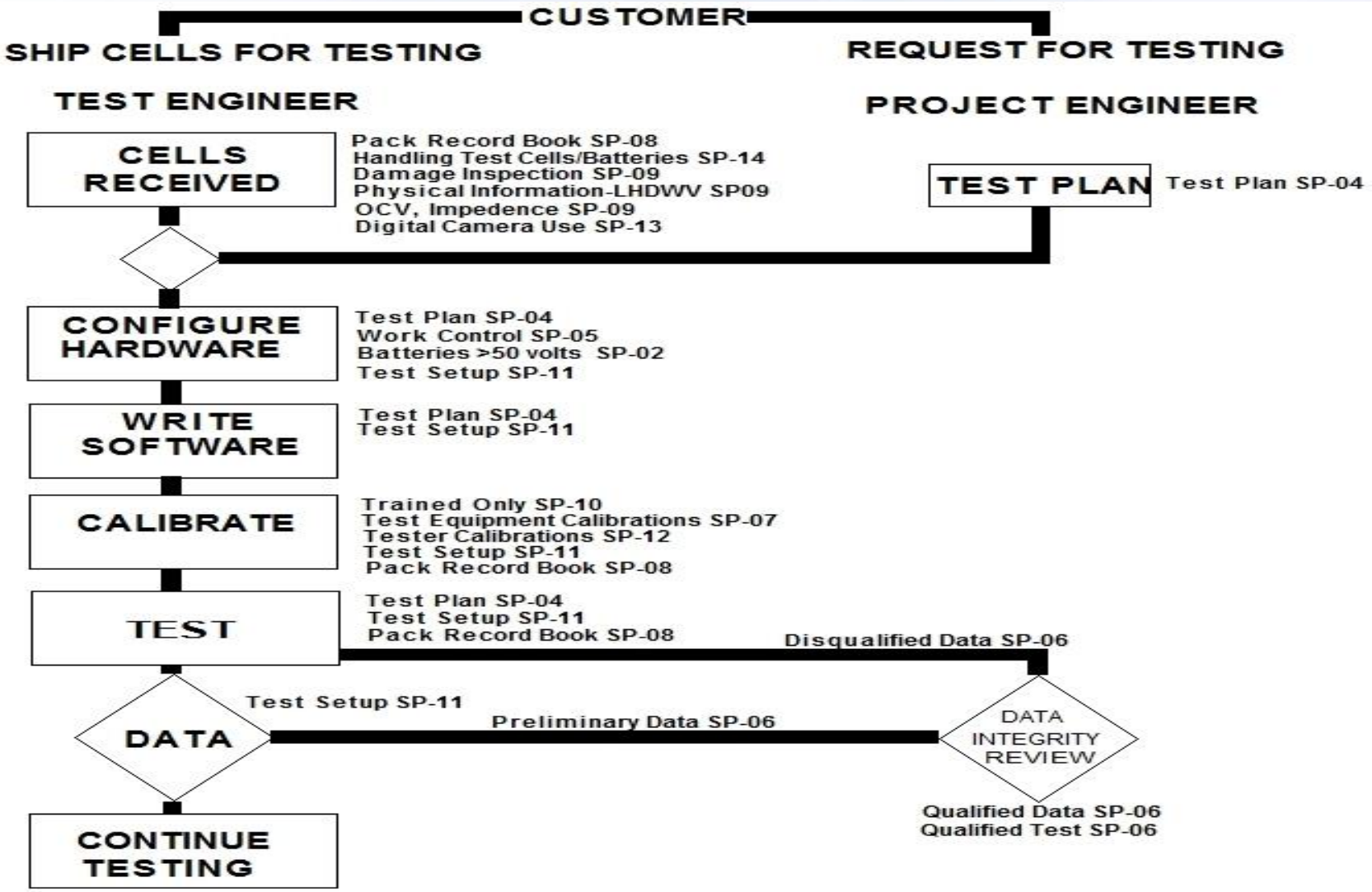
Equipment

- **Armature (640 mm or 25.2 in diameter)**
  - Sine force peak: 13,000 lbf
  - Random force peak: 12,500 lbf
  - Half sine peak shock force: 26,660 lbf
  - Velocity sine peak: 1.8 m/s (70.9 in/s)
  - Acceleration peak:
    - Sine: 392 m/s^2
    - Random: 392 m/s^2 ($40g_n$)
  - Displacement (continuous) peak to peak:
    - 63.5 mm (2.5 in)

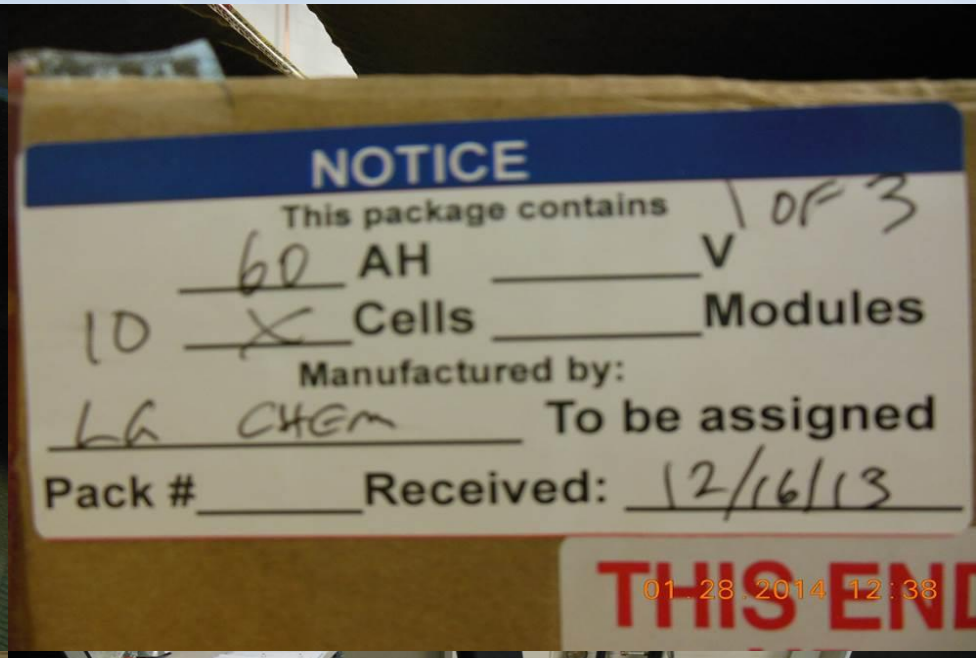
- **Horizontal and Vertical Axis Testing**
  - Magnesium slip plate (x & y axis): 96” x 72” with hydrostatic guide bearings on a 4” grid
  - Head expander (z-axis):
    - 72” x 72” with specimen mounting inserts on a 4” grid
    - Fully removable for smaller test articles
  - Weights:
    - Head expander: 1349 lbs
    - Slip plate: 875 lbs

- **8 Channel Data Acquisition Controller**

Workflow


CUSTOMER
SHIP CELLS FOR TESTING
REQUEST FOR TESTING
TEST ENGINEER
PROJECT ENGINEER
CELLS RECEIVED
Pack Record Book SP-08
Handling Test Cells/Batteries SP-14
Damage Inspection SP-09
Physical Information-LHDWV SP09
OCV, Impedence SP-09
Digital Camera Use SP-13
TEST PLAN
Test Plan SP-04
CONFIGURE HARDWARE
Test Plan SP-04
Work Control SP-05
Batteries >50 volts SP-02
Test Setup SP-11
WRITE SOFTWARE
Test Plan SP-04
Test Setup SP-11
CALIBRATE
Trained Only SP-10
Test Equipment Calibrations SP-07
Tester Calibrations SP-12
Test Setup SP-11
Pack Record Book SP-08
TEST
Test Plan SP-04
Test Setup SP-11
Pack Record Book SP-08
Disqualified Data SP-06
DATA
Test Setup SP-11
Preliminary Data SP-06
DATA INTEGRITY REVIEW
Qualified Data SP-06
Qualified Test SP-06
CONTINUE TESTING

Receiving


NOTICE
This package contains 1 of 3
60 AH ____ V
10 X Cells ____ Modules
Manufactured by:
LG CHEM To be assigned
Pack #____ Received: 12/16/13
THIS END
01.28.2014 12:38


EXIT
SHIPPER
LG CHEM POWER INC
1064 CHICAGO RD
TROY, MI 48083
CONSIGNEE
INL Battery Testing Center
1765 North Yellowstone HWY
Idaho Falls, ID
83415-3750
Attn: Jon P. Christophersen
CONTENTS
UN3480 Lithium ION Batteries
Class 9 Packing Group II
Gross WT: 13.4 kgs
01.28.2014 12:39


CARGO AIRCRAFT ONLY
9
01.28.2014 12:38

Receiving


CARGO AIRCRAFT ONLY
9
01.28.2014 12:38


01.28.2014 12:39

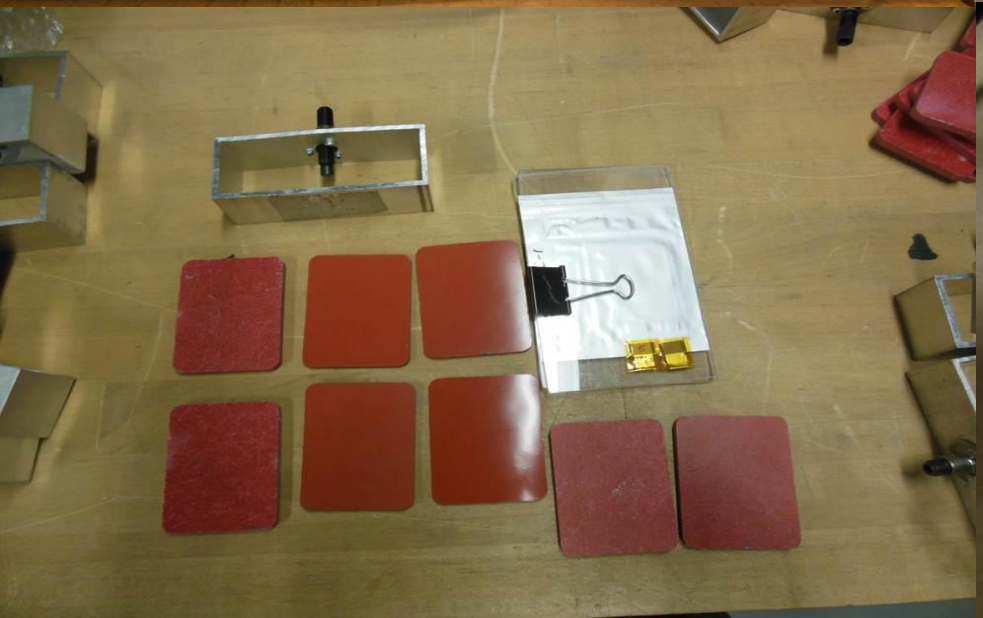

FedEx
HAZARDOUS MATERIALS
SHIPPING PAPERS
ENCLOSED

Receiving

Receiving

Receiving

Idaho National Laboratory

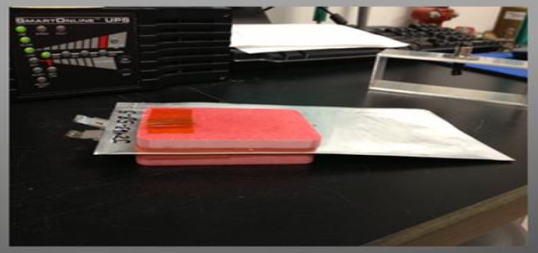


Receiving

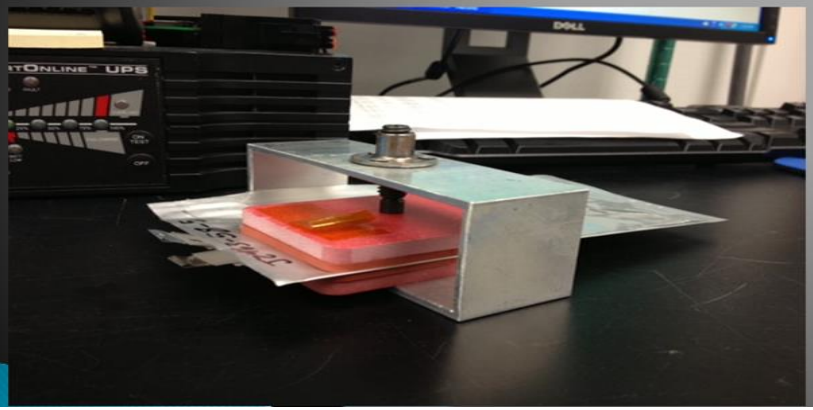
Jig Assembly Directions

Materials: metal fixture, 2 glass fiber plates, 2 rubber pads

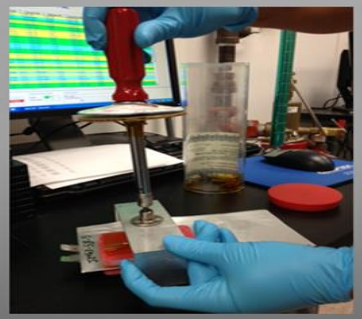
Step 1: Place each rubber pad on a glass fiber plate and put the cell in between the two rubber pads as shown below. Place the pads 1cm away from the top of the cell (where the cell name is located), and directly in line with the edge of side that the tabs are closest to.



Step 2: Place the cell in the metal fixture and position it so that the black rod would rest on the middle of the glass fiber plate. Lower the rod to the glass fiber plate.



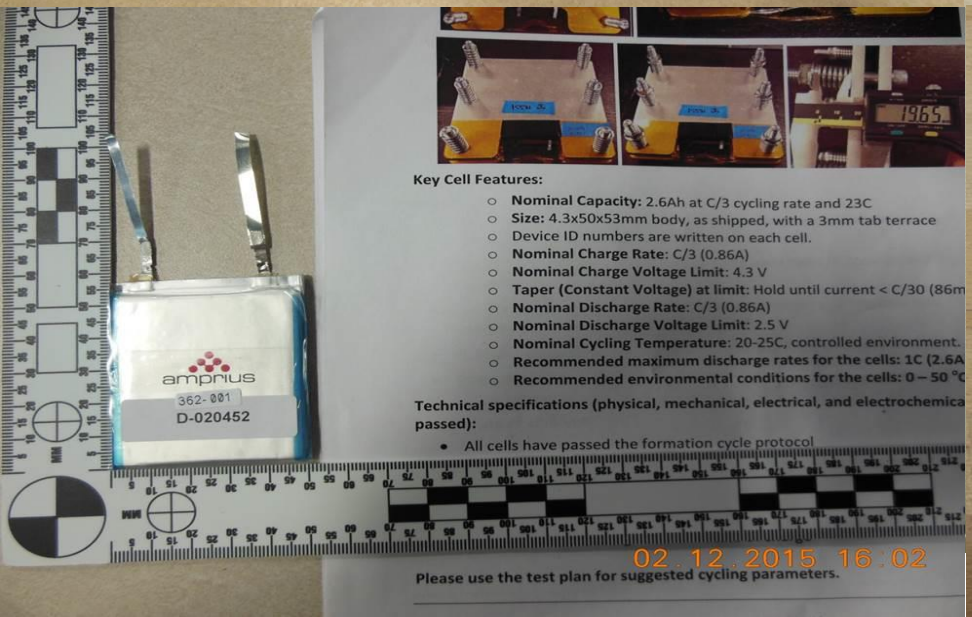
Step 3: Set a gauge to 5 inch-pounds of torque and use it to push down the rod further.



Step 4: Ready for testing.

Receiving

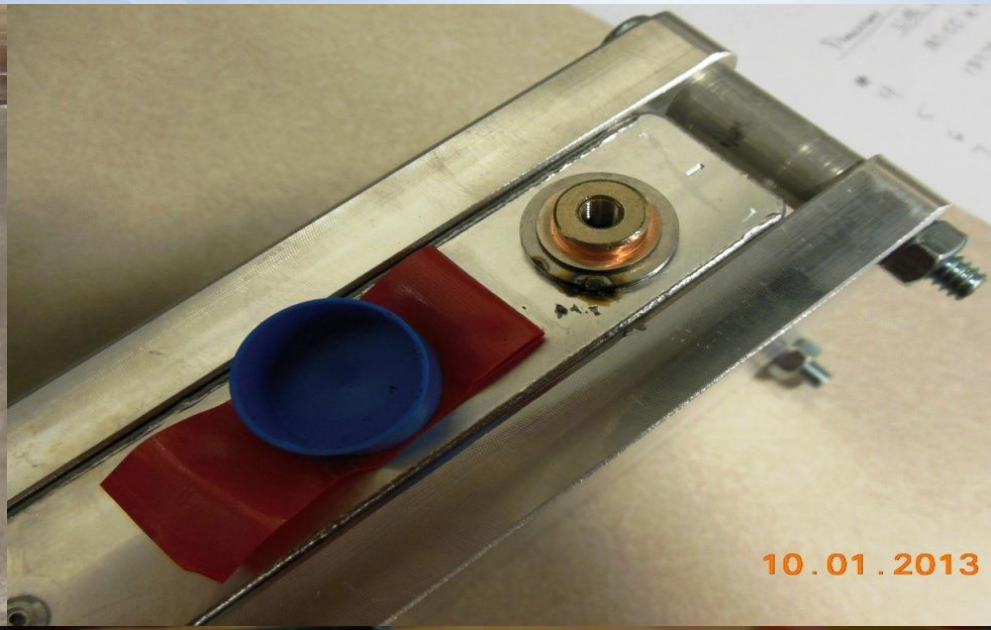
Idaho National Laboratory



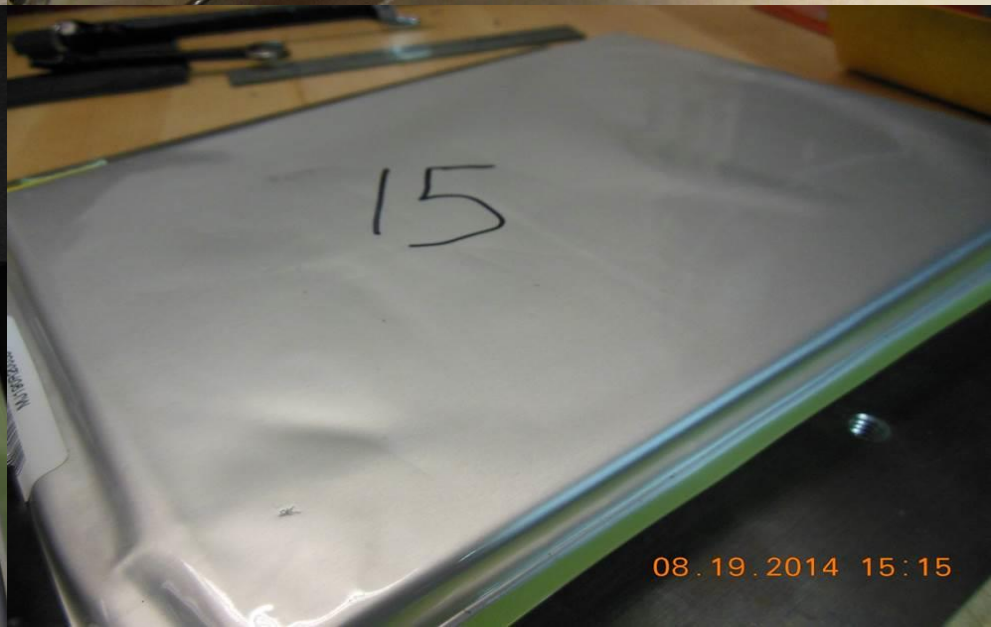
Cells

Cells

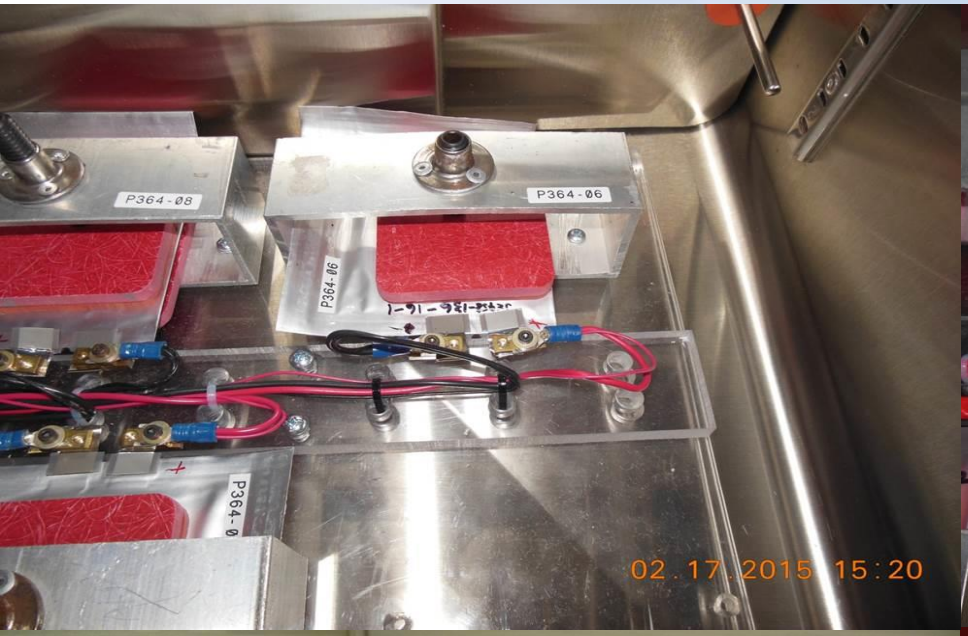

B0-1
02.27.2015 11:53
366-01

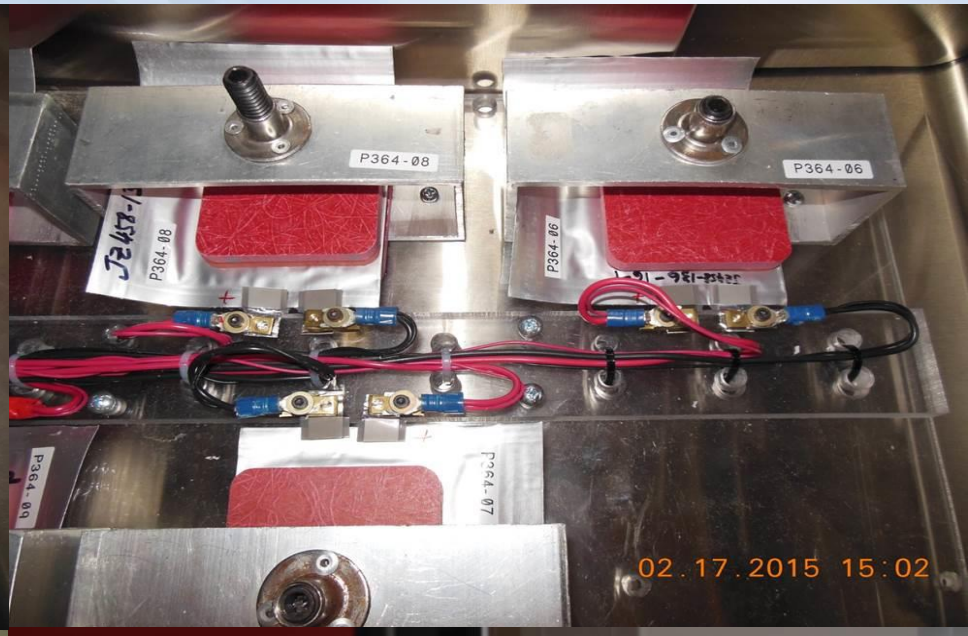

10.01.2013


CELL Model:Gen3-P2.6
MJ190R20009
01.28.2014 12:42


15
08.19.2014 15:15

Cells


P364-08
P364-06
02.17.2015 15:20


P364-08
P364-06
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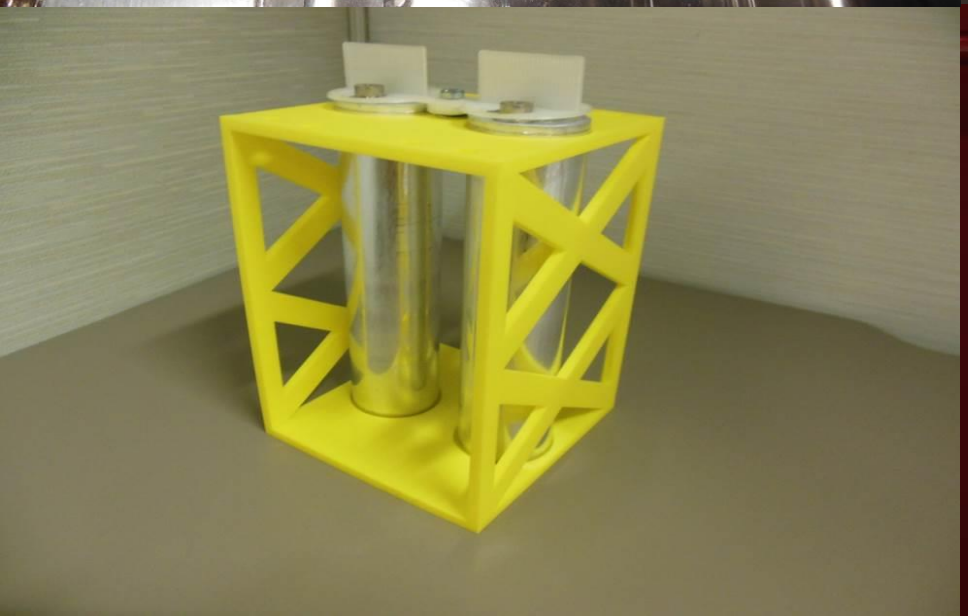
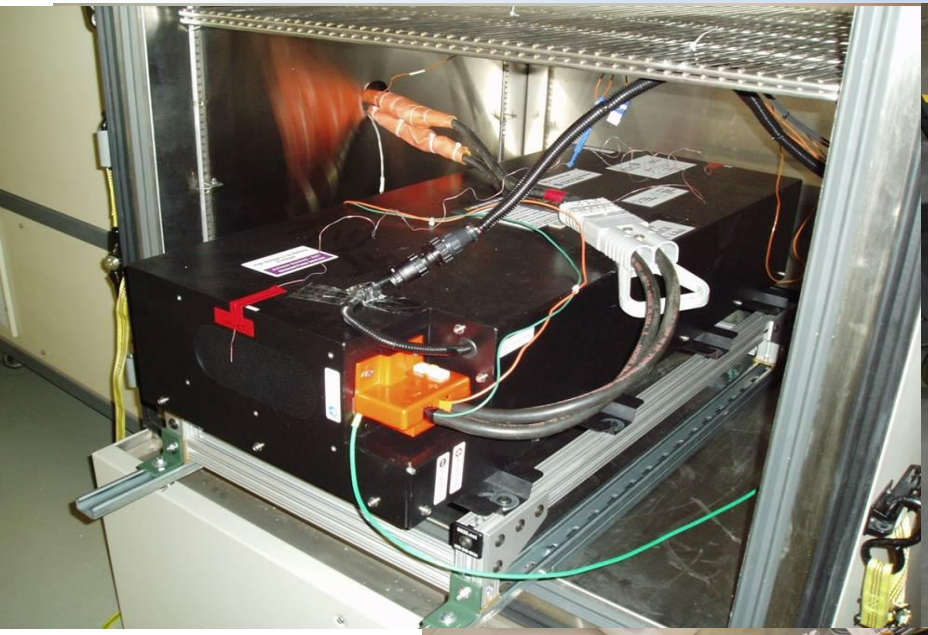



07.03.2014 08:58

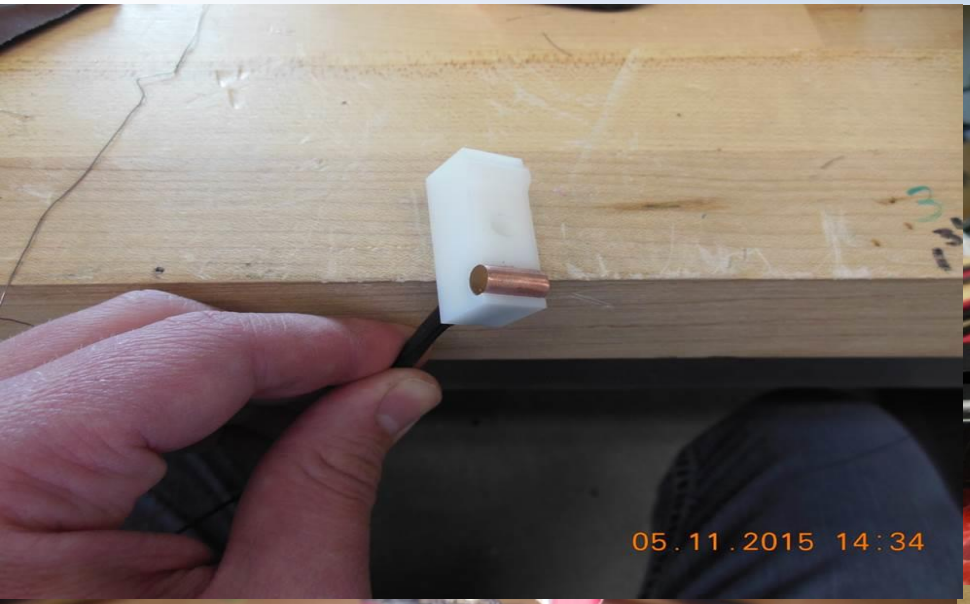
Packs

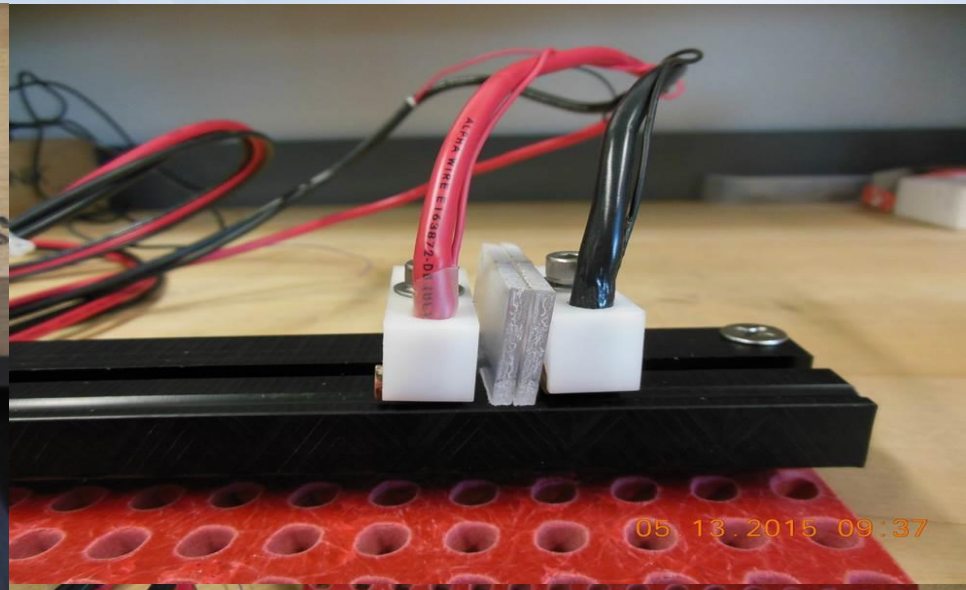


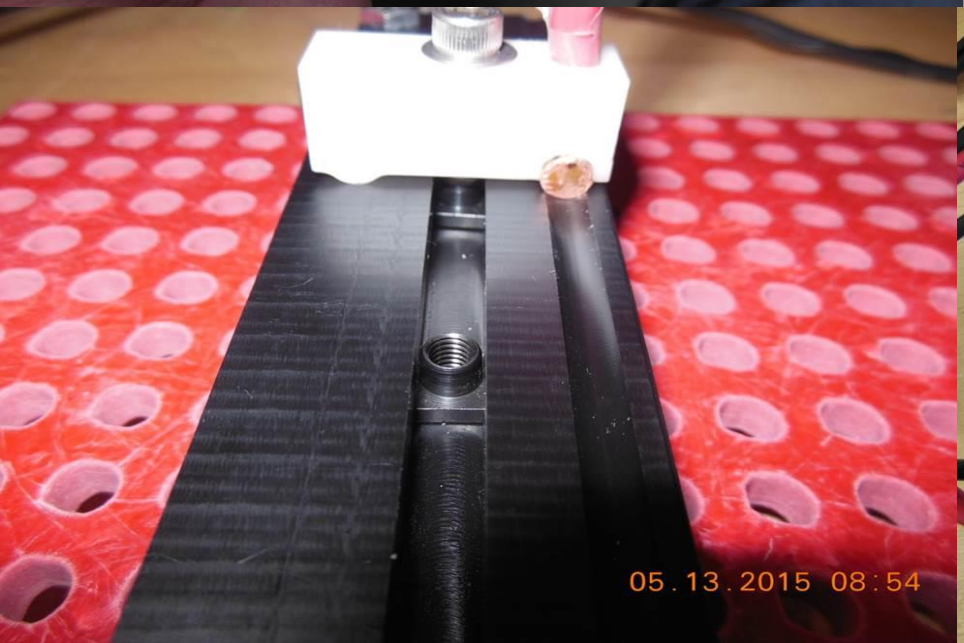
Setup

Fixtures

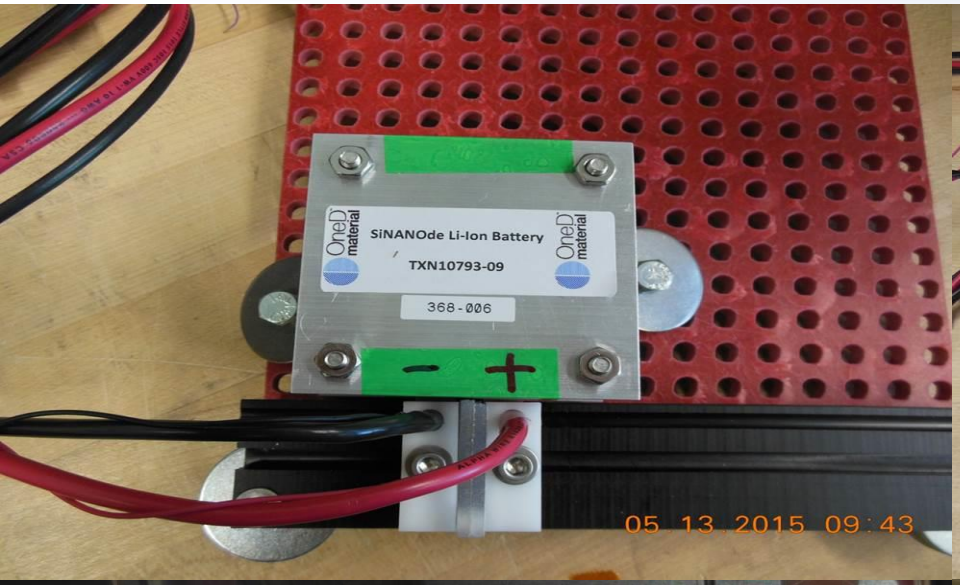
Standard fixture

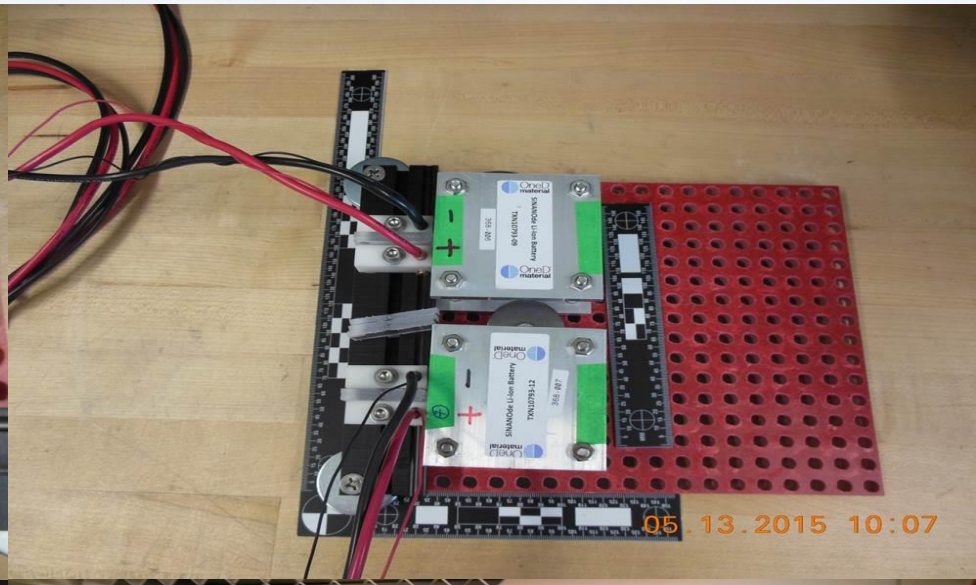




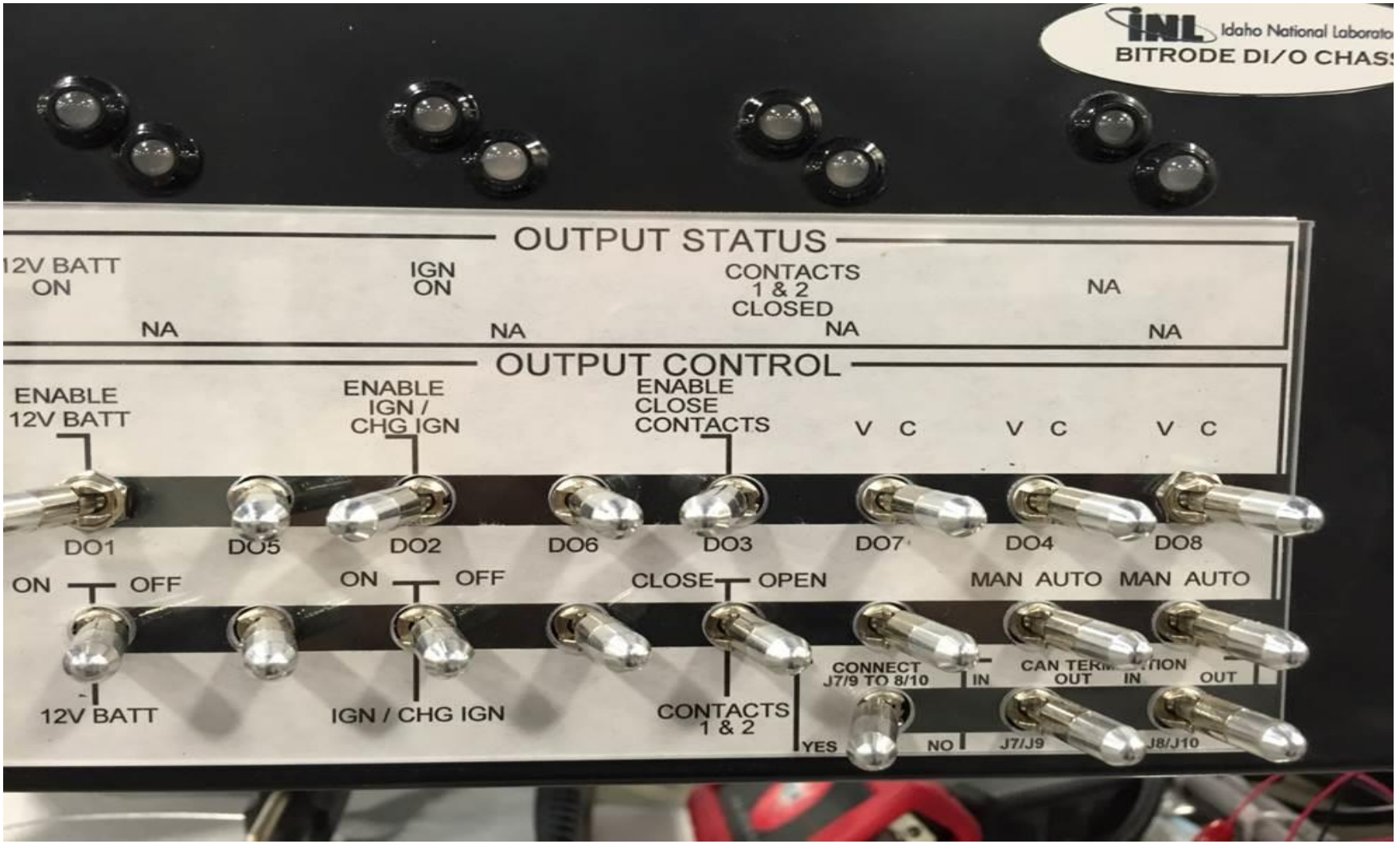


Standard fixture





CAM Controller



Summary

- The INL Battery Test Center is the lead DOE laboratory for advanced automotive battery performance testing.
  - 20,000 square feet of lab space with >700 test channels for advanced energy storage testing.
- INL is continuing to support DOE and USABC with science-based performance testing and assessment of candidate battery technologies for various vehicle platform applications.
  - Rigorous NIST traceable calibration procedures for in depth uncertainty analysis.
- INL has strong capabilities in advanced battery diagnostics and prognostics for improved state-of-health assessment.
  - On-going research activities in collaboration with DOE, NHTSA, SNL, and University of Maryland.
- *The INL Battery Test Center (BTC) evaluated 535 cells, 23 modules, and 3 packs for a total of 561 articles in FY-2014*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